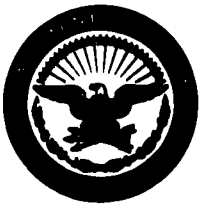

SUPER-POWER KLYSTRON TUBE-TEST FACILITY

G-108

Quarterly Report No. 8

for the period

July 1, 1962 through September 30, 1962

Prepared for

Varian Associates
611 Hansen Way
Palo Alto, California

RADIATION at Stanford

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Written by: Roby L. Blessing
Roby L. Blessing
Project Manager

Approved by: V. L. Smith
V. L. Smith
Chief Engineer
R-F Systems Division
RADIATION at Stanford

15 October 1962

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INTRODUCTION

During this quarter the high voltage transmission line was installed at the site complete with termination tank, bushings and innerconductor. This line was not filled with oil during the quarter but will be filled along with the klystron tank.

With the transmission line termination tank in position in the High-Voltage Building, the remaining corona shielding was installed on the capacitor banks. The installation of this shielding had been delayed until the termination tank was moved into the area in order to provide sufficient access. The installation of the silicon diode rectifier columns was also completed and the curtain wall was placed in position. The primary and control wiring was completed in this building during the quarter and the low voltage test phase was initiated.

Fabrication of the klystron/modulator tank was completed during the quarter and this tank was installed at the site. The klystron filament transformer was also installed in the pit, and both the transmission line and klystron filament transformer tank were connected to the klystron tank. The lead-lined cover was installed on the klystron portion of the klystron/modulator tank in order to allow the lead house to be placed in position. The cooling system components were delivered to the site and installed in position. The contract for the piping for this cooling system has been negotiated and the installation will be completed early in the first period of the next quarter.

The interim modulator pulse transformers were completed, installed in the pulse transformer tank and processed. The test program was initiated using the short pulse length transformer which operated satisfactorily. Tests on the long pulse length transformer were initiated but this transformer failed due to a high voltage breakdown. After this transformer was removed from the tank a detailed inspection was performed on the short pulse length unit. This inspection revealed a mechanical failure in the coil form. Consequently, both of these transformers were redesigned and rebuilt during the quarter. The transformers will again enter the test phase early in the next quarter.

Copies of the Machlett final report were received during this quarter, and the required number were transmitted to Varian. Work will not be continued under this portion of the contract.

I. BEAM SUPPLY

The high voltage beam supply installation was completed during the quarter with the exception of the klystron cathode resistor. This resistor continues to be stored at RADIATION at Stanford and will be installed in the High-Voltage Building at the completion of the power supply test phase. The space to be occupied by this resistor will be utilized during the power supply tests for a water load to test the power supply at full power. The low voltage checkout phases for this power supply were initiated near the end of the quarter, and will be completed about the middle of the first period of the next quarter. The 4160 volt input power to the building is scheduled to be applied about the middle of the first period of the next quarter and high voltage tests will be initiated at that time.

II. FINAL MODULATOR (Ground Deck, Buffer Deck and Floating Deck)

A final modulator stop work order is still in effect at this time. Consequently, no additional modulator design will be performed until RADIATION at Stanford receives official notification to proceed. RADIATION at Stanford was requested to supply a schedule for the design, construction and test of a final modulator using the Litton switch tube. We were also requested to supply cost and scheduling information to test and evaluate Litton switch tubes at RADIATION at Stanford. This information was supplied to Varian during the quarter. The final modulator program and the switch tube evaluation tests will be initiated at the time authorization is received.

III. MAGNET SUPPLIES

The status of the magnet supplies remains the same as previously reported. The supplies were delivered to Varian for use during the klystron magnet structure test program.

IV. KLYSTRON FILAMENT TRANSFORMER

This transformer was installed in the pit at the site along with the klystron tank during the quarter. This transformer is now available for the high voltage test phase.

V. MOD-ANODE BIAS SUPPLY AND ASSOCIATED COUPLING RESISTORS

The original packaging configuration utilized for these components was based on a final modulator using Machlett switch tubes. In order to be compatible with the packaging requirements of a modulator using Litton switch tubes, it has been necessary to modify the configuration of these items. At the end of the quarter this rework was nearing completion, and these units will be installed in the modulator section of the klystron tank during the first period of the next quarter.

VI. COOLING SYSTEM

The cooling system components were installed at the site during the quarter. Piping must be installed from the cooling system area to the water manifolds and to the interim modulator in order to complete this portion of the system. This piping will be completed early in the first period of the next quarter and at that time the system will be pressure tested prior to turn-on.

VII. D-C DUMMY LOAD

The required loads are available to perform the high voltage tests on the main beam supply. These tests are now scheduled to be initiated during the first period of the next quarter.

VIII. CONTROL CONSOLE

This console has been completed and delivered to the site. The installation will be completed on a schedule compatible with the installation of the interim modulator.

IX. COLLECTOR-CAPACITOR BANK

The installation of both the collector and body capacitor banks has been completed. These banks are now available for the high voltage test phase.

X. CROWBAR

At the beginning of this quarter authorization was received to proceed with the design and fabrication of the RADIATION at Stanford crowbar. The thyratron drive circuitry designed for this unit utilized solid-state devices. At the time these devices were to be placed on order, the vendor was experiencing an internal production and quality control problem, and as a consequence, could not deliver these devices. Since the devices are not available from a second source, it was necessary to redesign the drive circuitry. As an additional complication it was necessary to change the

thyratron choice because of questionable holdoff voltage characteristics. In this application it is necessary to apply continuous plate voltage to the thyratron, and recent data indicated that the particular thyratron chosen might malfunction by prefiring under this condition. An existing crowbar thyratron was again selected for the application. However, sufficient time delay data required to predict the total crowbar delay was not available. Since this crowbar system cannot introduce a total time delay greater than 1-1/2 microseconds between the time a fault occurs and the firing of the crowbar, it was necessary to evaluate the delay time characteristics of this tube. It was also necessary to design the drive circuitry with characteristics that would produce the minimum total crowbar delay. Both the thyratron evaluation and the drive circuitry redesign were completed during the quarter. Although the driver design was completed at the time sufficient data had been obtained from the thyratron tests, the tube has continued in an evaluation status in order to obtain long term data. These thyratron evaluation tests will continue although the results to date indicate that the tube will perform satisfactorily. The fabrication phase for this unit will continue through a portion of the next quarter, and the unit will be installed on site for the final system high voltage tests.

XI. CROWBAR LOGIC CIRCUITS

The crowbar logic circuitry design was completed during the quarter and was evaluated under operational conditions during the thyratron drive circuitry design phases. Minor modifications were necessary in order to integrate this circuit with the new drive circuitry design. The final fabrication of this unit will be completed early in the next quarter and it will be installed and operated at the site along with the main system crowbar.

XII. INTERIM MODULATOR POWER SUPPLY

This power supply is presently being utilized for interim modulator tests. It will be delivered to the site with the interim modulator pulse transformers at the conclusion of the test phase.

XIII. INTERIM MODULATOR PULSE GENERATOR

The circuitry has been used for interim modulator tests during the quarter and will be delivered to the site with the remainder of the interim modulator equipment.

XIV. INTERIM MODULATOR SWITCH DRIVE

Tests were completed during the quarter on this unit at the time the pulse transformers were tested. This unit will be delivered to the site with the interim modulator.

XV. INTERIM MODULATOR SWITCH TUBES AND PULSE TRANSFORMERS

The interim modulator pulse transformer test phase was intitiated during this quarter. The short pulse length transformer was first tested and no difficulties were encountered. The long pulse length transformer failed while in operation at a voltage level in excess of 300 kv. This transformer was removed from the tank and the damage evaluated. Both transformers were constructed with two primaries and one secondary on each leg of the core with the secondary mounted between the two primaries. The four primaries were connected in parallel and the two secondaries were connected in series. The failure occurred between the lower voltage secondary and the outer primary and resulted in damage to both the coil tubes and the windings. Although no damage was visible on some of the coil tubes, it was judged that all insulating coil parts should be replaced because of the possibility of invisible corona damage. The failure was due to three possible causes: (1) a coil form joint cracked during handling after winding; (2) inclusion of an air bubble in the epoxy during coil form assembly, (3) possible trapped air near the coil tube joint. A decision was made to modify the design before rebuilding the unit and resulted in the following changes: (1) elimination of the outer primary coil form, (2) use of a "tapered pad" coil form using a taper that would maintain the average stress between primary and secondary nearly the same throughout the coil lengths, (3) slight decreases in overall average stress, (4) use of larger diameter wire and corona shields to reduce

stresses at conductor surfaces, (5) very close attention to be given to the coil form assembly and succeeding handling operations. Although there was no indication of breakdown during the tests on the short pulse length transformer, a detailed inspection of this unit was performed to determine if any visible damage was present. This inspection revealed that a fracture had occurred in one of the coil forms although there was no visible evidence of high voltage breakdown. It was necessary to rebuild this transformer due both to the visible fracture and the possibility of concealed damage not visible during inspection. This transformer was rebuilt in the same manner as previously described for the long pulse length transformer. A transformer failure report was submitted during the quarter. Final assembly and processing of these units will be completed early in the next quarter. These units are now scheduled to again enter the test phase during the second week of the first period.

XVI. INTERIM MODULATOR CROWBAR, POWER SUPPLY AND TRIGGER

This equipment is being utilized as a part of the interim modulator test program and as it is located in the power supply cabinet it will be delivered to the site with the interim modulator power supply and associated equipment.

XVII. INTERIM MODULATOR CROWBAR LOGIC CIRCUITRY

The status of this circuitry remains unchanged. It is being utilized during the interim modulator test program.

XVIII. KLYSTRON TANK

The klystron tank was originally scheduled to be fabricated in sections and moved to the site for the final welding process. However, this tank was completely fabricated with additional temporary bracing members and positioned on its side and moved into the building through the available access. The grout support grid in the klystron pit was fabricated for the klystron/modulator tank and the klystron filament transformer during the quarter. The installation of the tank proper was also completed during the quarter. The lead-lined covers were completed and placed in storage at the vendor's location until such time as all components were in place inside the tank. The bias supply and associated resistors will be installed in the tank early in the next quarter and the covers placed in position. The cover for the klystron section of this tank was installed during the quarter in order to allow the lead house to be placed in position over this section. This cover has an opening approximately 42 inches in diameter designed to support the klystron magnet structure and this opening, along with a port on the tank side, will provide the necessary access.

XIX. SYSTEM LAYOUT

A detailed plumbing drawing including all pipe and control equipment was completed during the quarter and released to our vendor for the piping installation phases. Copies of this information was supplied to Varian upon its completion for their information and reference and to allow them to

coordinate their water connections with the water manifolds, etc.

The conduit and wiring layout drawings were revised during the quarter to meet the requirements of relocating all equipment from the mezzanine to the ground floor level at the site. These drawings were completed and released for bid during the quarter, and the installation of the wireways (gutters and/or conduits) will be initiated early in the next quarter. This work will be completed in advance of the interim modulator installation phase at the site.

XX. PULSE-COUPLING CAPACITOR

The physical location of this capacitor at the site requires that the interim modulator pulse transformers be placed in position before installing this capacitor. This assembly will be delivered to the site during the first period of the next quarter. However, it will not be placed in its final position until the pulse transformer tank has been installed.

XXI. PULSE-VIEWING RESISTOR

The status of this resistor remains unchanged. It is now being utilized for high voltage measurements as required.

XXII. SWITCH TUBE TEST SUPPLY

This supply has been utilized during this quarter to perform high voltage measurements for the high voltage breakdown study program. It was also utilized to perform four d-c evaluation tests on mod-anode bushings.

This supply will continue to be used during the next quarter for high voltage measurements and mod-anode bushing evaluations if required.

XXIII. INPUT POWER CONTROL UNIT

The wiring from this unit to the Inductrol and to the plate transformer was completed during the quarter. The control circuitry test phases were initiated and will continue in conjunction with the remaining control circuitry tests in the High-Voltage Building. The 4160 volt circuitry will be tested at the beginning of the high voltage test phase and these tests are now scheduled to be initiated about the middle of the first period of the next quarter.

XXIV. MACHLETT SUBCONTRACT

The only work performed on this contract at Machlett Laboratories during the quarter was completion of the final report. This report was received during the quarter and the required number of copies were forwarded to Varian at that time.

XXV. SWITCH TUBE DRIVER CIRCUITRY

This equipment has not been utilized during this quarter. It may be used during final modulator design phases at the time an authorization is received to continue with that design.

XXVI. CONCLUSIONS

During this quarter the high voltage transmission line, the klystron tank, the cooling system components and the control console were delivered to the site. One interim modulator pulse transformer failed during high voltage tests and, consequently, the interim modulator was not delivered to the site as previously scheduled. The control console will not be placed in its final position until the interim modulator is delivered. The fabrication of the new pulse transformer using the new design will be completed early in the first period of the next quarter, and these transformers will again enter the test phase during the second week of the first period. It was necessary to reschedule various phases of the program in order to rebuild the pulse transformers while minimizing the overall program delays. Although approximately five weeks was necessary for the transformer rebuild program, the final equipment completion date was extended by only two weeks.

The High-Voltage Building fabrication and wiring was completed during the quarter and the low voltage test phase was initiated. This phase will be completed early in the next quarter, and the high voltage test program will be initiated about the middle of the first period, which is compatible with the availability of 4160 volt power to the building.

The switch tube test supply was utilized during this quarter for high voltage breakdown measurements as a part of the high voltage study program and was also utilized to perform tests on four mod-anode bushings. This

power supply will continue to be used for high voltage tests and bushing evaluations if requested.

The Machlett Laboratories switch tube development program will not continue. The final efforts under this program were directed toward producing the final report which was received and transmitted during this quarter.

XXVII. PROGRAM FOR THE NEXT INTERVAL

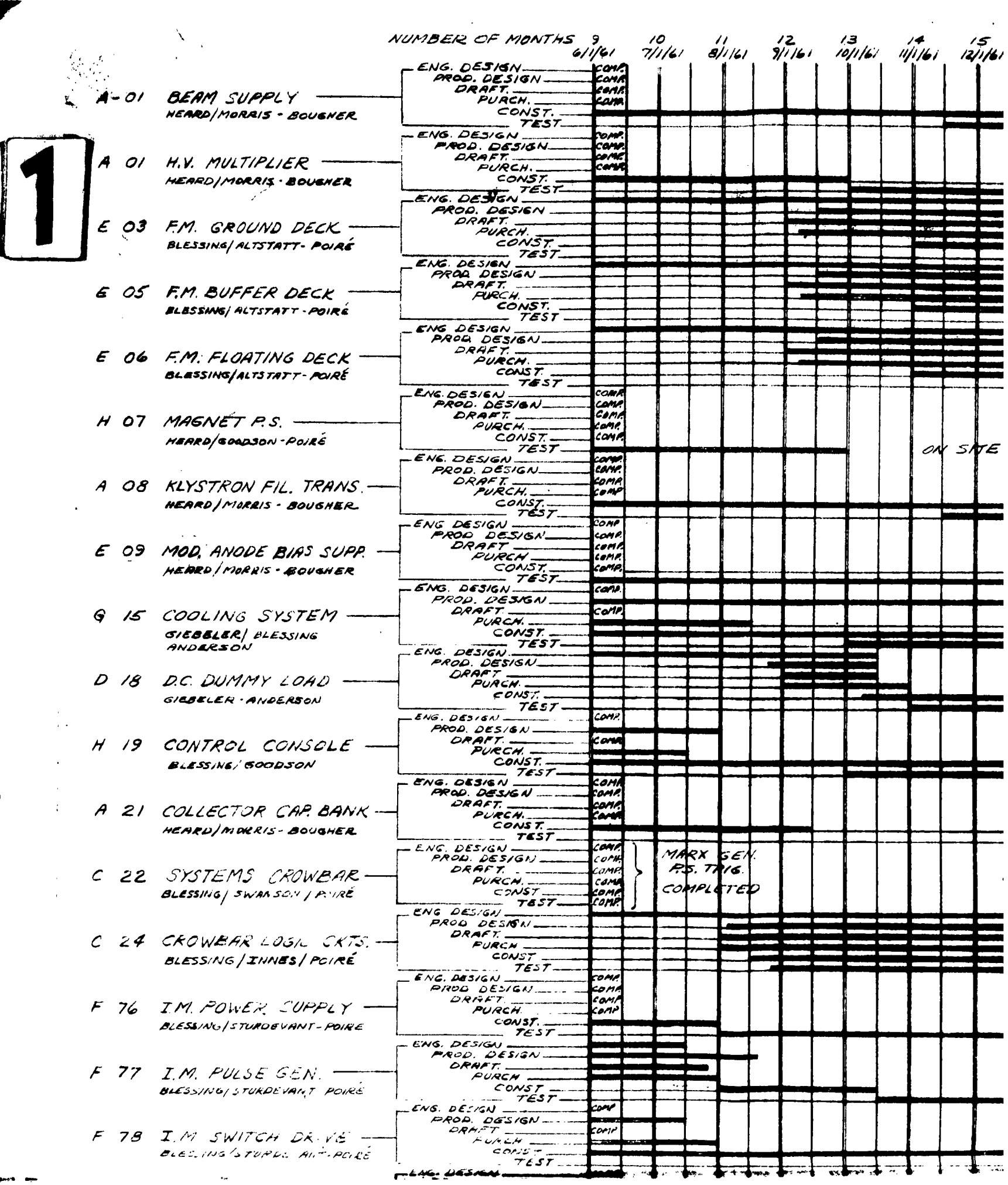
During the next quarter a significant portion of the effort will be directed to equipment tests. The high voltage power supply will enter the high voltage test phase and upon its completion high voltage tests will be initiated on the remainder of the system. These tests are scheduled for completion during the quarter. The interim modulator pulse transformers will again enter the test phase and at the completion of this program the modulator will be installed at the site. The on-site checkout of the remaining control equipment will be initiated at that time. Production Engineering and Production effort will continue in the areas of the crowbar, mod-anode bias supply and associated resistors, the installation of the klystron cathode resistor and the completion of the wiring phases to the control console and interim modulator. High voltage breakdown measurements will continue on the high voltage study program and these measurements are scheduled for completion during the next quarter. Additional mod-anode bushing tests will be performed if required and requested by Varian. These additional tests

have not been scheduled at this time and will be performed at the request of Varian in conjunction with the high voltage studies.

The crowbar is scheduled for completion during the next quarter and this assembly will be installed in the High-Voltage Building and final tests performed in conjunction with the high voltage power supply.

XXVIII. TECHNICAL PERSONNEL ASSOCIATED WITH THIS PROJECT

R. L. Blessing, overall Project Manager; J. Sturdevant, interim modulator Project Manager; support technical personnel include L. H. Groh, H. Jessup, A. Poire, T. Innes, G. Reeser. Engineering facilities were managed by A. J. Morris; Production Engineering and Drafting facilities by W. Bougher, and Production facilities were managed by E. Anderson.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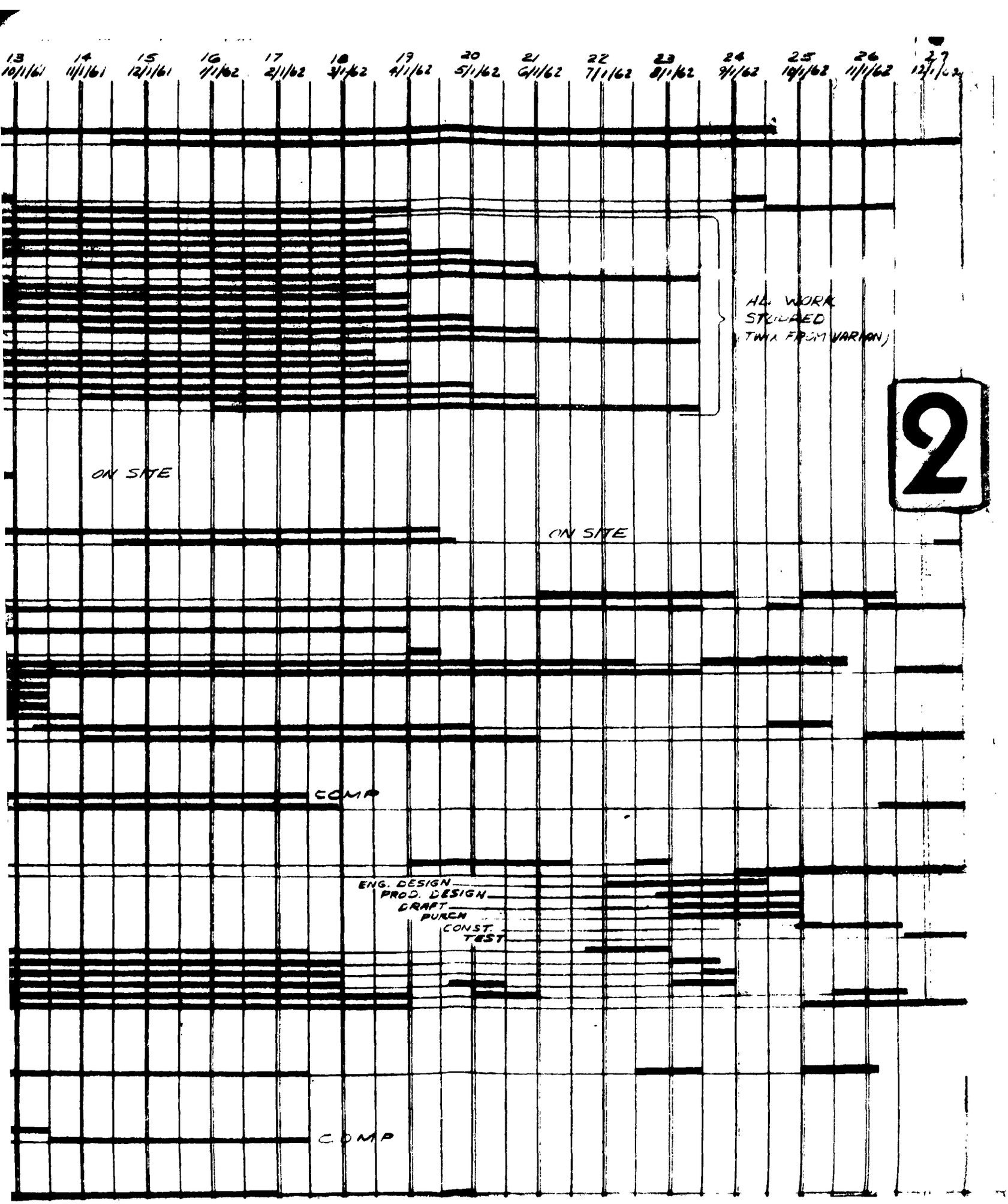
A-01 BEAM SUPPLY
HEARD/MORRIS - BOUGHER
A 01 H.V. MULTIPLIER
HEARD/MORRIS - BOUGHER
E 03 F.M. GROUND DECK
BLESSING/ALTSTATT - POIRÉ
E 05 F.M. BUFFER DECK
BLESSING/ALTSTATT - POIRÉ
E 06 F.M. FLOATING DECK
BLESSING/ALTSTATT - POIRÉ
H 07 MAGNET P.S.
HEARD/GOODSON - POIRÉ
A 08 KLYSTRON FIL. TRANS.
HEARD/MORRIS - BOUGHER
E 09 MOD. ANODE BIAS SUPP.
HEARD/MORRIS - BOUGHER
G 15 COOLING SYSTEM
GIEBELER/BLESSING
ANDERSON
D 18 D.C. DUMMY LOAD
GIEBELER - ANDERSON
H 19 CONTROL CONSOLE
BLESSING/GOODSON
A 21 COLLECTOR CAP. BANK
HEARD/MORRIS - BOUGHER
C 22 SYSTEMS CROWBAR
BLESSING/SWANSON/POIRÉ
C 24 CROWBAR LOGIC CKTS.
BLESSING/INNES/POIRÉ
F 76 I.M. POWER SUPPLY
BLESSING/STURDEVANT - POIRE
F 77 I.M. PULSE GEN.
BLESSING/STURDEVANT POIRÉ
F 78 I.M SWITCH DRIVE
BLESSING/STURDEVANT-POIRÉ
ENG. DESIGN
PROD. DESIGN
DRAFT.
PURCH.
CONST.
TEST
COMP.
MARX GEN. P.S. TRIG. COMPLETED
ON SITE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TEST
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C 24 CROWBAR LOGIC CKTS.
BLESSING / INNES / POIRÉ

F 76 I.M. POWER SUPPLY
BLESSING / STURDEVANT - POIRÉ

F 77 I.M. PULSE GEN.
BLESSING / STURDEVANT - POIRÉ

I 78 I.M. SWITCH DRIVE
BLESSING / STURDEVANT - POIRÉ

F 79 I.M. SW. - P.T.-CLIPPER
BLESSING / STURDEVANT - POIRÉ

F 80 I.M. CROWBAR P.S. TRIG.
BLESSING / STURDEVANT - POIRÉ

F 81 I.M. CROWBAR LOGIC
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A 82 BODY CAP BANK
HEARD / MORRIS - BOUGHER

A 83 KLYSTRON TANK
BLESSING / HEARD - POIRÉ

J 84 SYSTEM LAYOUT
BLESSING / HEARD - POIRÉ

F 85 PULSE COUPLING CAP.
HEARD / MORRIS - BOUGHER

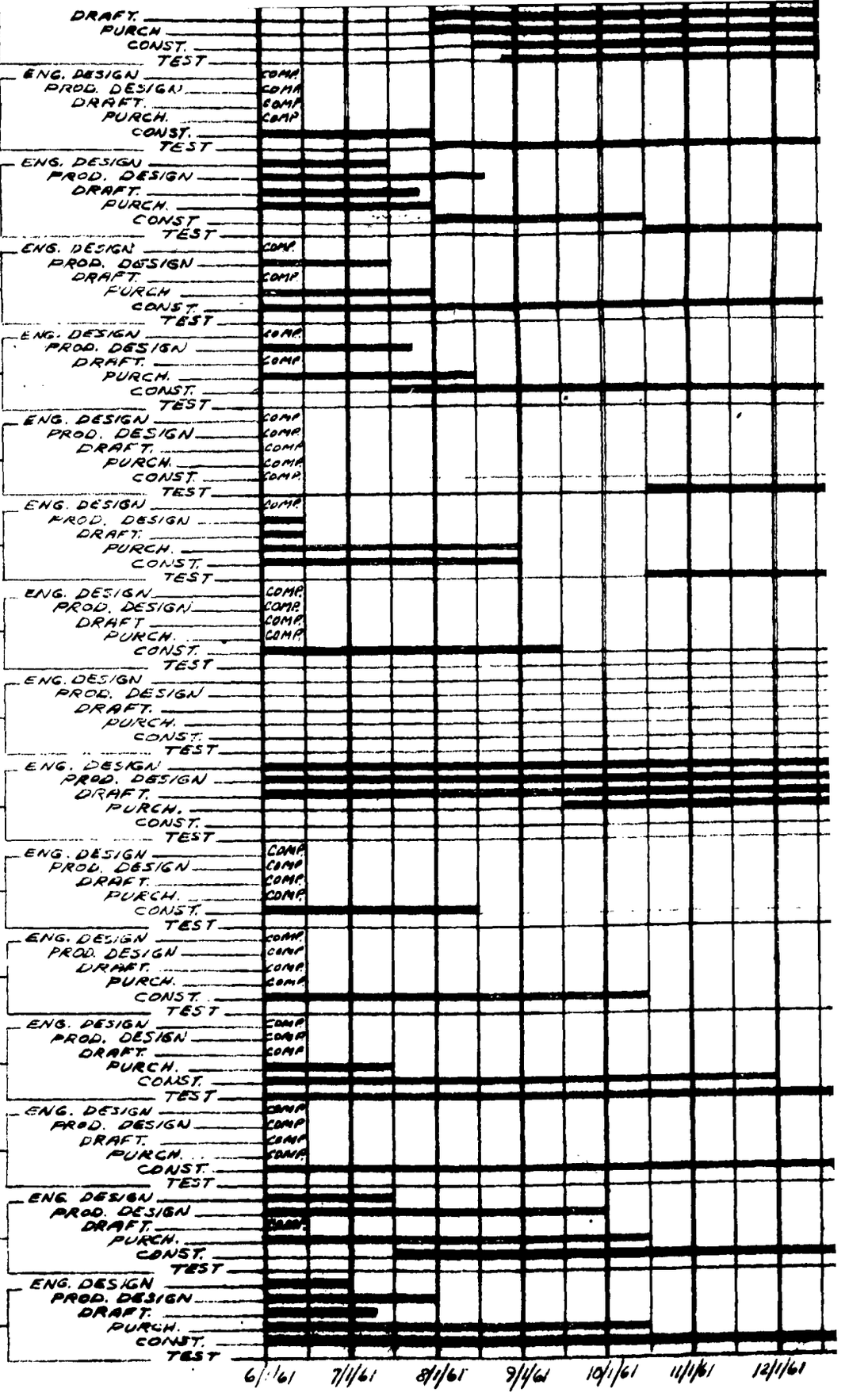
E 86 PULSE VIEWING RESISTOR
ALTSTATT / ANDERSON

E 87 SWITCH TUBE TEST SUPP.
ALTSCHULT / ALTSTATT - ANDERSON

F 88 PULSE TRANS. LOADS
GIBBELER - ANDERSON

A 89 INPUT POWER CONTROL
BLESSING / HEARD - POIRÉ

F 90 I.M. MAJOR SUB-ASSEMBLIES
BLESSING / STURDEVANT - POIRÉ



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RADIATION at Stanford / 3180 Hanover Street Palo Alto, California

PROJECTED SCHEDULE FOR POWER SUPPLY MODULATOR SYSTEM (G108)

7-12-62 D103 6024

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